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Abstract

EVALUATION, STORAGE AND PROCESSING OF NUCLEAR DATA FOR REACTOR COMPUTATIONS

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Through the use of large computers reactor calculations are nowadays much more precise and detailed than was possible in the early years of the atomic energy industry. This advance is being supported by large numbers of neutron cross-section measurements of improved accuracy and extent. However preparation of the derived quantities needed for reactor calculations can be extremely laborious. To surmount this difficulty in a systematic way workers in the UKAEA are building up a data library on punched cards and magnetic tape of the complete range of basic nuclear cross-sections which are needed, with versatile processing programmes to generate the derived quantities.

Part 1 of the paper describes this work. The process of evaluation of cross-sections for the library is discussed. For a library to be useful in reactor calculations it must contain a complete range of data for the most important materials. Thus the initial stage of its construction is quite a large undertaking: it is now complete so far as the UKAEA data library is concerned. At the present time this contains neutron cross-section data in the range 1 meV to 15 MeV for 39

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materials, including angular and energy distributions of secondary neutrons. Some gamma ray cross-sections in the range 10 keV to 20 MeV are also available.

The format of the library is very flexible, and both tabular and parametric representations of the data are allowed. The latter have considerable advantages in some parts of the energy range if computer programmes are available for their interpretation. Some such programmes are in use and others are being developed. Because the data are very numerous several ancillary programmes are used to mechanise jobs such as checking, altering and printing the library.

The principal "processing programmes" developed for general use with the library are GALAXY, which generates multigroup cross-sections, and DICE which prepares the data for Monte Carlo calculations and aids consultation of the prepared data.

To extend the library and keep it up-to-date in the light of new measurements is a continuing task which is likely to become more exacting and urgent as the output of new experimental data increases. International collaboration is needed, to obtain full value from the experimental work. Some informal collaboration has already been started.

Part 2 summarises work on the evaluation of data on the thermal neutron scattering law; several of the points made in general terms in part 1 are aptly illustrated by this example. The differential scattering cross-section cannot be measured over the whole range of initial and final energies and scattering angles at all the temperatures required. So it is necessary to make considerable use of theory in interpreting and extrapolating the measurements. The adequacy of the scattering laws obtained in this way are checked by appeal to measurements of neutron spectra in moderating assemblies.